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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/811,927

03/30/2004

Junji Noguchi

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EXAMINER

AU, BAC H

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 08/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/811,927

Applicant(s)

NOGUCHI ET AL.

Examiner

Bac H. Au

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 June 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☒ Certified copies of the priority documents have been received in Application No. 09/825,946.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Terminal Disclaimer

1. The terminal disclaimer filed on June 12, 2006 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of U.S. Pat. 6,764,950 has been reviewed and is NOT accepted.

The application/patent being disclaimed has been improperly identified since the number used to identify the U.S. Pat. 6,348,410 being disclaimed is incorrect. The correct number is U.S. Pat. 6,764,950.

Claim Objections

2. Claims 1 and 13 are objected to because of the following informalities:

Regarding claim 1, "electro plating" in line 17 should be --electroplating--;

"exposing the first insulating film" in step (g) should be --exposing the second insulating film--;

"surface of the first insulating film" in step (h) should be --surface of the second insulating film--;

"surface of the first insulating film" in step (i) should be --surface of the second insulating film--.

Regarding claim 13,

"exposing the first insulating film" in step (g) should be --exposing the second insulating film--;

"surface of the first insulating film" in step (h) should be --surface of the second insulating film--;

"surface of the first insulating film" in step (i) should be --surface of the second insulating film--.

Because of the limitation of step (b) where a hole is formed in the first insulating film and the hole being connected to a bottom surface of the groove, the first insulating film must be under the second insulating film. Consequently, the second insulating film (which is on top) is exposed in steps (g) - (i), and not the first insulating film.

Appropriate correction is required.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

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3. Claims 1-20 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-12 of U.S. Patent No. 6764950 in view of Ngo (U.S. Pat. 6348410).

Regarding claims 1-20, Patent '950 discloses most of the limitations of the claims. Patent '950 fails to disclose

- (a) forming a second insulating film over a first major surface of a wafer;
- (b) forming a groove in the second insulating film;
- (c) performing an ammonia plasma treatment to an exposed surface in the groove and hole and a top surface of the second insulating film,
- (d) forming a barrier metal film over inner surfaces of the groove and the hole and over an upper surface of the second insulating film.

However, Ngo [Fig.3] discloses a method wherein

- (a) forming a second insulating film [210] over a first major surface of a wafer;
- (b) forming a groove [204] in the second insulating film;
- (c) performing an ammonia plasma treatment to an exposed surface in the groove and hole and a top surface of the second insulating film [Col.5 lines 46-50; col.4 lines 54-58],
- (d) forming a barrier metal film [232] over inner surfaces of the groove and the hole and over an upper surface of the second insulating film.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Ngo into the method of '950 to include

- (a) forming a second insulating film over a first major surface of a wafer;
- (b) forming a groove in the second insulating film;
- (c) performing an ammonia plasma treatment to an exposed surface in the groove and hole and a top surface of the second insulating film,
- (d) forming a barrier metal film over inner surfaces of the groove and the hole and over an upper surface of the second insulating film.

The ordinary artisan would have been motivated to modify '950 in the manner set forth above for at least the purpose of having multiple metallization layers in the manufacture of integrated circuits, and using the damascene technique to eliminate metal etch and dielectric gap fill steps [Col.3 lines 18-23].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Edelstein (U.S. Pat. 6181012) in view of Lai (U.S. Pat. 6136680) and Maekawa (U.S. Pat. 6171957).

Regarding claims 1 and 13, Edelstein [Figs.2 and 4A-4D] discloses a method of fabricating a semiconductor integrated circuit device comprising:

(a) forming a first insulating film [100 bottom] and second insulating film [100 top] over a first major surface of a wafer;

(b) forming a groove in the second insulating film and a hole in the first insulating film, the hole being connected to a bottom surface of the groove [84];

(d) forming a barrier metal film [72] over inner surfaces of the groove and the hole and over an upper surface of the second insulating film;

(e) forming a copper seed layer [86] over the barrier metal layer inside and outside the groove and the hole by copper sputtering with a copper target;

(f) forming a copper film [90] containing copper as its principal component on the copper seed layer inside and outside the groove and the hole by electroplating so as to fill the groove and the hole [Col.7 lines 57-60];

(g) removing the barrier metal film, the copper seed layer and the copper film formed on the copper seed layer outside the groove and the hole so as to leave a copper interconnection in the groove and the hole, thereby exposing the second insulating film [Figs.4C-D; col.7 lines 43-45];

(i) forming an insulating barrier film [101] on the exposed surface of the second insulating film and the upper surface of the copper interconnection by plasma CVD;

(i) forming an insulating barrier film [101] on the exposed surface of the second insulating film and the upper surface of the copper interconnection by plasma CVD, wherein the total concentration of components other than copper in the copper

interconnection, when step (h) is completed, does not exceed 0.8 At % [Col.7 line 64 – col.8 line 4].

Edelstein fails to disclose in the method comprising

(c) performing an ammonia plasma treatment; hydrogen plasma treatment; to an exposed surface in the groove and hole and a top surface of the second insulating film;

(e) sputtering with a copper target having a purity of 99.999% or more;

(h) performing an ammonia plasma treatment to the exposed surface of the second insulating film and an upper surface of the copper interconnection.

However, Lai [Fig.7; col.7 lines 25-37] discloses a method comprising

(c) performing an ammonia plasma treatment; hydrogen plasma treatment; to an exposed surface in the groove and hole and a top surface of the second insulating film;

(h) performing an ammonia plasma treatment to the exposed surface of the second insulating film and an upper surface of the copper interconnection.

Maekawa [Fig.1d; col.6 lines 23-39] discloses forming a copper film by (e) sputtering with a copper target having a purity of 99.999% or more.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Lai and Maekawa into the method of Edelstein as described. The ordinary artisan would have been motivated to modify Edelstein in the manner set forth above for at least the purpose of removing oxides from the exposed surfaces and improves the bonding between the dielectric and the copper

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film [Lai; col.7 lines 25-37]; as well as having a high purity copper film preventing deterioration due to oxidation [Maekawa; col.6 lines 23-39].

Regarding claims 2 and 14, Edelstein, Lai, and Maekawa disclose wherein the purity of said copper target is not less than 99.9999% [Maekawa ; Fig.1d; col.6 lines 23-39 discloses purity of 99.999 wt% or higher].

Regarding claims 3-6 and 15-17, Edelstein, Lai, and Maekawa [Edelstein; col.7 line 64 – col.8 line 4] disclose

wherein the total concentration of components other than copper in the copper interconnection, when step (h) is completed, does not exceed 0.8 At %;

wherein the total concentration of components other than copper does not exceed 0.08 At %;

wherein the total concentration of components other than copper does not exceed 0.05 At %;

wherein the total concentration of components other than copper does not exceed 0.02 At %;

wherein the total concentration of components other than copper does not exceed 0.2 At %.

Regarding claims 7-9 and 18-20, Edelstein, Lai, and Maekawa [Edelstein; col.9 lines 61-62] disclose

wherein the film thickness of the thinnest part of the barrier metal film in the groove and the hole is less than 10 nm;

wherein the film thickness is not more than 3 nm;

wherein the film thickness is not more than 2 nm, or there is no metal barrier film;

wherein the film thickness is not more than 5 nm.

Regarding claims 10-12, Edelstein, Lai, and Maekawa [Edelstein; col.9 lines 50-54] disclose

wherein a width of said groove does not exceed 0.4 μm ;

wherein a width of said groove does not exceed 0.25 μm ;

wherein a width of said groove does not exceed 0.2 μm .

Conclusion

5. The Terminal Disclaimer filed was disapproved because the wrong patent number was used. Patent number 6,348,410 should be 6,764,950. The Double Patenting rejection is therefore maintained.

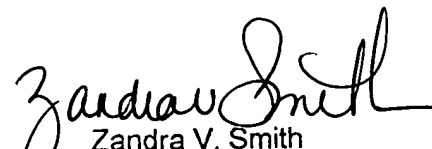
The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bac H. Au whose telephone number is 571-272-8795. The examiner can normally be reached on Mon-Fri 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BHA


Zandra V. Smith
Supervisory Patent Examiner
18 Aug 2006